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Measuring perceptual and motivational facets of computer control: The development and validation of the computing control scale

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Abstract

The Computing Control Scale (CCS), a new factor analytically derived psychometric instrument is developed. The CCS consists of Computing Autonomy and Computing Need for Control subscales. Computing autonomy represents a composite of confidence in controlling computers and self-reliance when using computers. Computing need for control is considered to represent a domain-specific analog of Burger's (e.g. 1992) global desire for control construct. The factor structure of the instrument is shown to be replicable. Also, the two subscales are shown to be reliable and to exhibit construct validity in terms of their differential relationships with other concepts such as computer comfort - anxiety, computer addiction and non-domain-specific desire for control. In addition, the data collected shows that few people attribute computing-related outcomes to luck or chance and indicates that the vast majority of people believe that in principle such outcomes are within their control. It is therefore concluded that attempts to measure computing-specific locus of control using a factor analytically derived instrument may not be viable.

Keywords: Internal External Locus of Control; Needs; Self Efficacy; Computer Attitudes; Independence (Personality); Addiction

1. Introduction

Much research into individual differences in computing behavior and attitudes has used locus of control as a predictor. Results of this research have been mixed, effects sometimes being identified and sometimes not. Studies have used general measures of locus of control rather than computing-specific measures, and this might partially account for the failure to find effects in some studies. One aim of the present research then, was to develop a computing-specific locus of control measure. Locus of control concerns people's *perceptions* of whether there is a contingency between one's actions and outcomes. Another type of perceptual control construct involves whether people perceive that they have the ability to perform behaviors and thereby control outcomes. Psychologists construe such perceptions in terms of self-efficacy or confidence. Although measures of computing self-efficacy / confidence exist, items in the measures do not explicitly deal with control issues. A second purpose of the present project was to remedy this. A final aspect of the present work aimed to develop a measure of need for control over computers. Rather than involving perceptions of control, this construct involves *motivation* to control. This issue has been neglected in the computing literature, but is likely to be of major importance in relation to computer-related stress and addiction.

In the following three sections, each conception of control is considered along with its applicability to computing behavior and attitudes, and the way in which it was taken into account in developing the presently constructed instrument.

1.1 Locus of control

The concept of locus of control (Rotter, 1966) sprang from Rotter's social learning theory in which the potential for a behavior to occur is considered to be a function of one's expectancy (subjective probability) that a given reinforcement will occur as a result of the behavior and the value one attaches to that reinforcement. Expectancies can be either specific to a particular situation or more generalized with a gradient between the two (Rotter, 1990). Locus of control involves a generalized expectancy concerning the extent to which environmental reinforcement tends to be contingent upon one's own efforts and behaviors (internal control expectancy) or upon external influences such as chance, luck and powerful others (external control expectancy) (Rotter, 1990). Thus, externals entertain low subjective probabilities that a particular reinforcement (e.g. success on a task) will result from their behavior, while the subjective probabilities of internals in this respect are higher. Because of these differences in expectancy, people with internal control expectancies are more highly motivated to master their environment since they believe that their efforts are likely to lead to positive outcomes (Phares, 1976). In contrast, externals are less highly motivated towards environmental mastery because they perceive that their efforts have little influence on outcomes. Thus, internals and externals have been found to differ with respect to a host of mastery-related variables: information seeking, expression of a willingness to remedy personal inadequacies, persistence in giving up smoking, learning, utilization of knowledge etc. (Phares, 1976).

With respect to computing behavior and attitudes, the above suggests that internals will build-up greater computing confidence and exhibit lower computer anxiety than externals because of their greater motivation to master computing environments.

Much work has tested such hypotheses since negative attitudes towards computing in general, and computer anxiety in particular, are seen as potentially damaging to an individual's educational and wider life chances. While some studies have shown greater externality of locus of control to be positively related to anxiety, and / or negatively related to attitudes (e.g. Coovert & Goldstein, 1980; Igbaria & Parasuraman, 1989; Hoffman, Novak and Schlosser, 2000; Potosky and Bobko, 2001), null findings are common (Hawk, 1989; Howard & Smith, 1986; Crable, Brodzinski, Scherer & Jones, 1994; Anderson & Hornby, 1996), and on occasion the direction of the relationship is even reversed (Woodrow, 1990).

The work of Hoffman *et al*. (2000) is of particular interest since it shows that contemporary work involving locus of control fits in with the observation that findings from studies of Internet-related behavior and attitudes reflect patterns often seen in the older literature concerning computer attitudes in general (Durndell & Hagg, 2002). Hoffman and her colleagues used Levenson's (e.g. 1981) Internality, Powerful Others and Chance (IPC) Scales in which internality and externality are viewed as independent and in which there are two externality subscales. They found that earlier adopters of Internet technology were characterized by greater internality, and lower expectancies regarding outcomes being largely determined by powerful others or chance (both external dimensions). Similar results were found with respect to feelings of comfort with computers in general, and, for internality and external powerful others, comfort with respect to the Internet in particular. The Internet-related results supported the idea that internals adopted the technology more quickly because it allows them to exert direct (primary) control over their environment (note though that such an explanation involves need for control at least as much as locus of control). On the other hand, a belief in control over outcomes by powerful others was positively related to greater Internet usage in terms of hours per day. This supported the idea that individuals with such beliefs use the Internet in an ‘experiential’ manner: for leisure activities such as chat, entertainment, etc. Other findings included the observation that greater internality was associated with usage of the Web for less instrumental, more goal-directed, activities such as shopping, researching, seeking information on home products, etc. This is consistent with the tendency of internals to engage in greater information seeking (Phares, 1976).

There is a long-standing assumption by major locus of control researchers that domain-specific locus of control measures should provide better prediction in a particular domain than more general global measures (Lefcourt, 1991). Thus, while the early general measures of locus of control (e.g. Rotter, 1966; Levenson, 1981), are still in use, these measures have been supplemented by domain-specific measures for research in areas such as health, aging, alcoholism and academic achievement and affiliation (see Lefcourt, 1981). The failure of the early literature on locus of control and computing attitudes to demonstrate robust relationships and the present surge in research using locus of control to predict Internet-related behavior provided much of the impetus for the present attempt to design a computing-specific locus of control scale. No such attempt appears to be recorded in the literature despite the large amount of attention paid to non-domain-specific locus of control as a possible predictor of computing variables.

Generation of locus of control items for the present instrument took cognizance of the structure of Levenson’s (e.g. 1981) IPC Scales. Internal items involved the ideas that the success of one’s interactions with computers is dependent upon ability and effort. Some external items were centered upon the possibilities that chance, luck or fate can be responsible for success, while other items involved the role of powerful others. The latter items were split into two areas: humans as powerful others and computers as powerful others. The first of these reflected the traditional locus of control literature. The second took account of the possibility that the interactive nature of computing could lead to the perception that some outcomes were attributable to the unpredictable nature of computers and their software, irrespective of design features built into systems by human powerful others.

Because the results of the factor analytic process necessitated reformulation of hypotheses intended to validate a locus of control subscale emerging from the present analyses, development of these hypotheses is left until the Results section.

1.2 Perceived self-efficacy / confidence in controlling computers

In addition to locus of control, self-efficacy is another important control-related concept in social learning theory (or latterly social cognitive theory - Bandura, 1991, 1997). Whereas locus of control involves beliefs that outcomes are in principle within or without one's control, perceived self-efficacy constitutes a conception of control in the form of whether one perceives that one has control over whether one can perform a certain behavior in terms of having the requisite ability (Ajzen, 2002). Perceived inability to control computers has been cited as a major reason for 'technophobia' (Hill, Smith & Mann, 1987).

Research shows that locus of control and self-efficacy beliefs are largely independent of each other (Bandura, 1997). Feelings of self-efficacy coupled with locus of control (whether one has an internal or external control expectancy, resulting in one's estimate that a particular action will result in a specific outcome) determine one's efforts in mastering an activity (Bandura, 1991). Applying Bandura's (1997) observations to the domain of computing and considering circumstances in which an individual believes that they cannot control computers (i.e. has negative computer self-efficacy) then if this is coupled with a belief that computing outcomes are not personally determined (external locus of control) one will experience resignation or apathy with respect to mastering computers. On the other hand, if one has negative computer efficacy but believes that computing outcomes are personally determined (internal locus of control) one will experience self-devaluation or despondency with respect to one's computing efforts. Neither of these two combinations is likely to lead to attempts to master computers. Turning to positive self-efficacy, if one believes that one can control computers and believes that computing outcomes are personally determined, then one will be productively engaged with computers. (It is not clear what would be expected where positive computer self-efficacy beliefs are paired with an external locus of control).

Research on perceived computing self-efficacy conducted during the 1980s showed males to exhibit more positive self-efficacy perceptions than females (Miura, 1987; Murphy, Coover & Owen, 1989). Also, Hill *et al.* (1987) showed perceived self-efficacy to predict enrollment in computer-related courses irrespective of the perceived instrumentality of enrolling, and that perceived self-efficacy was related to previous computing experience and usage of electronic technologies other than computers. More recent work has confirmed the continuing existence of a sex difference in perceived self-efficacy, its relationship with computing experience and with previous attendance on a computer training course (Cassidy & Eachus, 2002).

According to Bandura (1997), an effective measure of perceived self-efficacy should be domain-specific and tap beliefs as to capabilities across several types of situation at different levels of complexity within the domain. However, Cassidy and Eachus (2002) argued that the advent of graphical user interfaces (GUIs), and in particular the ubiquity of Windows environments, has made some of the computing self-efficacy scales used in 1980s research obsolete since many of the computing tasks mentioned were associated with different types of computing package and GUIs have rendered many of the tasks associated with packages the same. The aforementioned authors therefore produced what they considered to be a general domain-specific measure of perceived computer self-efficacy, including items which were non-task-specific and which did not represent differing levels of complexity.

Despite the fact that computer self-efficacy has been defined in terms of expectations as to whether one can control computers (Hill *et al.*, 1987), neither the instruments developed during the 1980s nor that of Cassidy and Eachus (2002) had a specific focus upon controllability. However, the relevant items included in the present instrument were focused upon this construct. To render them similar to other items in the instrument under construction, the items aimed to tap perceptions of computers' controllability in general, rather than controllability associated with specific computing tasks. In this respect then, they had something in common with the items of Cassidy and Eachus (2002). But, given that the present items did not measure perceived capabilities in controlling computers across several types of computing situation at different levels of complexity as demanded by Bandura (1997), despite the lead given by Cassidy and Eachus (2002), the idea that these items constituted a prospective measure of perceived self-efficacy in controlling computers was avoided. Instead, it was considered more reasonable to conceive of them as measuring confidence in one's ability to control computers. Use of the term 'confidence' signifies that the items measure something akin to perceived self-efficacy in controlling computers without contravening Bandura’s strictures on the content of self-efficacy measures. The idea that computer confidence and perceived computer self-efficacy are highly similar is supported by the occasional synonymous usage of these two terms by both Cassidy and Eachus (2002) and Brosnan (1998). Also, equating self-efficacy beliefs with confidence in one’s capacity to carry out a behavior is said to be consistent with Bandura’s conception of self-efficacy (Ajzen, 2002).

As for the locus of control subscale, the results of the factor analytic process made it necessary to reframe hypotheses aimed at validating a possible confidence in controlling computers subscale. Therefore, again, development of these hypotheses is left until the Results section.

1.3 Need for control

In addition to attempting to develop measures of *perception* of control in the domain of computing (indices of computing locus of control and confidence in controlling computers), the present research also aimed to develop a measure of computing need for control: an index of *motivation* to control computers. As far back as 1980, Shneiderman emphasized that desire for control is an important factor in people’s interactions with computers. However, the importance of this factor in the design of interfaces and other software is likely to differ across individuals according to how strong their desire for control is.

One researcher active in the area of control motivation is Burger who has developed the Desirability of Control (DC) Scale as a general measure of this construct (Burger & Cooper, 1979). Desirability for control and locus of control tend to be related, with

DC Scale scores displaying reasonable relationships (absolute correlations in the range .36 to .46) with scores on all three dimensions (Internal, External Powerful Others and External Chance) of Levenson's (1981) IPC Scales (Burger, 1984). This seems reasonable in that people who have a high desire for control are likely to make persistent attempts to influence outcomes and these attempts are likely to be successful at least some of the time. On the other hand, the attempts of people low in desire for control to influence outcomes are likely to be less frequent, and such people will therefore have fewer opportunities to learn that outcomes are likely to be contingent upon their actions. Even when the latter type of person does make an attempt to control outcomes, in many instances they will do so in a more half-hearted manner and their attempts at control will therefore be less successful than those of the high DC person, thereby reinforcing an external control expectancy.

In spite of the relationship between desire for control and locus of control, the distinction between these two constructs has proven to be of empirical use. For example, people high in desire for control, low in internality and with a belief that outcomes are determined externally by chance and powerful others are more likely to seek help from others when they have a depressing problem than other types of individual classified by their joint scores on locus of control and desire for control measures (Burger, 1992). Thus, given the utility of the desirability of control construct, Burger and other researchers have used the DC scale in investigations of behavior across a wide range of situations (e.g. social interaction, academic performance, sexual behavior, health-related behavior and gambling behavior – see Burger [1992] for a review). Also, just as happened with locus of control instruments, Burger and Cooper's global scale has now been joined by domain-specific instruments such as those measuring desire for control in the workplace and control over dental treatment (Burger, 1999).

Desirability of control is viewed largely as a positive attribute by Burger and Cooper (1979). People high on this personality dimension are '…assertive, decisive and active', seek to '…influence others…', prefer '…to avoid unpleasant situations or failures by manipulating events to ensure desired outcomes' and seek '…leadership roles in group situations.' (quotations from Burger & Cooper, 1979, p.383). Likewise, computing-specific need for control is likely to have advantages, the day by day quest for control over computers being likely to lead to greater computing proficiency and knowledge. However, there is also likely to be a down side.

In general, '… computer users come to expect rapid performance … and a high degree of control…' (Shneiderman [1998], p.593, citing the 1984 writings of Brod). A computer's failure to meet these expectations of rapid performance and control is likely to result in frustration with resultant anger and stress. For example, Wallace (1999) noted that slow download times are a major complaint among Internet users, and this is likely to be particularly true for people with a high need for control over computers. It is also easy to conceive of other computing situations in which a high need for control is likely to lead to extreme frustration: situations where in principle computers should be controllable but where in practice they are not. Such situations include erratic cursor control resulting from malfunctioning mice, computers crashing and hanging, autocorrect and autoformatting features of software making unwanted changes to documents, and non-optimal response times resulting from computer multitasking and high traffic on corporate networks.

So, the present research effort aimed to develop a computing-specific measure of control motivation since, although such a scale would constitute a useful research tool, no such instrument appears to exist.

The need for control items included in the pool of items for the present questionnaire were intended to represent a computing-specific form of Burger's general Desirability of Control measure. The items tapped motivational issues surrounding both satisfaction obtained from getting computers to do what one wants them to and the general desire to have as much control as possible over computers when using them. Additionally, items involving self-reliance were included. These items sought to tap the extent to which individuals were willing to rely upon their own efforts in seeking to control computers or to rely upon others. This reflected Burger's (1992) observation that factor analysis of DC scale responses revealed an Avoidance of Dependence factor among others, and it was envisaged that including items tapping computing self-reliance should make the resultant instrument useful for educational and vocational research.

In validating the present Need for Control subscale it was assumed that the possibility of exerting a high degree of control over one's environment, which computing affords, would result in a positive relationship between computing need for control scores and computer addiction scores. This reflects the observation that a high need for control can be an important part of the psychological make-up of computer addicted or dependent people (Weizenbaum, 1984; Shotton, 1989; Levy, 1994). As a domain-specific measure of need for control it was also hypothesized that computing need for control would exhibit a moderate positive relationship with scores on Burger and Cooper's (1979) global Desirability of Control measure.

Of the three types of Levenson locus of control score, internality displays the greatest absolute relationship with DC scores (Burger, 1984; 1992). It was therefore expected that the magnitude of the positive correlation between computing need for control and internality would be greater than the negative correlations between computing need for control and the Powerful Others and Chance scores. Although Burger gives no reason why Internality scores should exhibit the highest correlation with DC scores, the observation that highly internal people experience greater stress in uncontrollable situations than in controllable situations (Franken, 1998) suggests that they are generally characterized by high need for control and provides a partial rationale for the present hypothesis.

In summary, the present project aimed to use factor analytic methods to develop a psychometric instrument measuring the three computer-related conceptions of control discussed above. On derivation of factorially valid subscales, studies of replicability, reliability and validity were undertaken.

2. Method

2.1 Design

The initial pool of items for the Computing Control Scale (CCS) consisted of 60 items falling into six broad classes on an *a priori* basis: Internal Causality (Effort and Ability), Chance/Luck/Fate and Powerful Others (both Humans and Computers) as external causal factors, Confidence in Controlling Computers, Need for Control and

Self-Reliance. Within each of these categories and subcategories an attempt was made to keep a balance between positively and negatively phrased items.

Items were phrased in the first person rather than the third person. This was identified by Levenson (1981) as one important difference between her scale and that of Rotter (1966), and seems a reasonable approach since it ensures that an instrument will tap an individual's personal control perceptions and motivations. The instrument aimed to tap conceptions of control as they apply to computer users, and therefore most of the items were focused upon perceptions and motivations while using computers. This makes the instrument suitable for use only with people having computing experience, although such experience may be minimal.

The same six-point Likert scaling procedure as that adopted by Levenson was adopted, people responding on a numerical scale of -3, -2, -1, +1, +2 and +3 corresponding to labels of Strongly Disagree, Moderately Disagree, Slightly Disagree, Slightly Agree, Moderately Agree and Strongly Agree respectively. Here, an even number of choice options prevents the choice of a middle placed neutral option as a response set.

The project consisted of a number of phases. Subsequent to initial screening of items, exploratory factor analyses were performed. The resultant factor structure was then cross-validated and measures of subscales' internal consistency and test-retest reliability were obtained. Finally, the CCS subscales were subjected to validation analyses using four other psychometric instruments.

2.2 Respondents

In total, 233 people (143 females and 90 males, age range = 18 to 64 years, mean age = 38.95 years, SD = 12.28 years, with missing age data for 12 people) formed the development sample. Respondents included 173 members of academic, administrative and technical staff working at a higher education institution in the north of England, and 55 undergraduate and postgraduate students at the same institution (occupational data was missing for 5 respondents). Inclusion of these different types of individual helped to ensure heterogeneity of the sample so as to maximize variability in the responses obtained, which is an important pre-requisite for an adequate factor analysis (Kline, 2000).

Subsequent to its derivation, the final version of the questionnaire was cross-validated using a sample of 203 undergraduate and postgraduate students studying either Psychology, Tourism Management or Business. These respondents consisted of 151 females and 48 males (gender of 4 unknown) in the age range 18 to 57 years (mean = 25.91 years, SD = 8.60 years, age unknown for 7 respondents).

Test-retest reliability was determined using a subsample of 43 students from the cross-validation sample. These students were all on modular undergraduate degree courses involving some study of psychology. The sample consisted of 32 females and 11 males in the age range 18 to 52 years (mean = 26.98 years, SD = 8.66 years, age data missing for 1 respondent).

All respondents had some experience of using computers (see Design and Procedure). Given the nature of the development sample, it is probable that the quantity and quality of this experience varied widely across respondents. This was considered desirable as it facilitates use of the final instrument with a wide range of computer users.

2.3 Materials

Four instruments were used to assess the validity of the CCS subscales. The first validation instrument was a version of the Computer Apathy and Anxiety Scale (CAAS; Charlton & Birkett, 1995) revised by Charlton (1999, 2002) to include a Computer Addiction subscale, and referred to here as the CAAS-R. This 33 item instrument contains three subscales measuring computer anxiety – comfort (13 items), computer apathy – engagement (8 items) and computer non-addiction – addiction (12 items), with high scores indicating a greater orientation towards computers. Items consist of positively and negatively worded statements. People respond to these items on a 5-point Likert-type scale ranging from Strongly Disagree to Strongly Agree. Only the scales measuring anxiety - comfort and non-addiction - addiction were involved in the present validation analyses.

The Internality, Powerful Others and Chance Scales (Levenson, e.g. 1981) were used as a second validation instrument. As mentioned in the Introduction, this is a general locus of control scale with subscales measuring expectancies on the three eponymous dimensions, the second two of which measure two separate dimensions of externality. This instrument consists of 24 items with 8 items per subscale. Responses are given on a 6-point Likert-type scale with numbered responses representing answers ranging from Agree Strongly to Disagree Strongly. Responses are scored so that high scores indicate greater internality, greater belief in control by powerful others and greater belief that outcomes are determined by chance / luck.

Burger and Cooper's (1979) Desirability of Control (DC) scale constituted a third validation instrument. This 20 item instrument consists of statements concerning preferences for tasks and situations which involve exerting control. People respond to statements on a 7-point scale ranging from "Never Applies to You", through "Applies Half the Time" to "Always Applies to You". A high score indicates greater desirability of control.

Because socially desirable responding has been identified as a major problem with locus of control scales, the Marlow-Crowne Social Desirability Scale (Crowne & Marlowe, 1960), was used as a final validation instrument. Here, people have to respond either "True" or "False" as to whether they engage in 30 types of socially desirable and undesirable thoughts and behaviors expressed as statements. Items involve thoughts and behaviors which people commonly engage in / do not engage in although social norms dictate that one should not / should respectively. Responses are keyed so that a high total score indicates greater socially desirable responding.

2.4 Procedure

Questionnaires for the development phases of the study (the exploratory factor analysis and validation phases) were distributed simultaneously along with an explanatory letter giving non-specific details of the study. Participation was voluntary but completion of questionnaires was encouraged by offering the incentive of entry into a lottery for a total of £60 (around $88) in cash prizes for the return of completed questionnaires. Means of distribution and collection differed slightly for different types of respondent. Questionnaires for higher education employees were distributed and collected by means of the institution's internal mail system, while course tutors were responsible for distributing and collecting questionnaires from students. Care was taken not to place pressure upon students to participate. No instructions as to order of questionnaire completion were given. At least one other psychometric questionnaire was given along with the CCS for validation purposes. All responses were treated in the strictest confidence. People with no computing experience were asked to return the questionnaire uncompleted (these people were still entered for the lottery).

CCS test–retest and cross-validation data was collected from students only. Tutors administered and collected questionnaires during timetabled classes. Participation was again voluntary. Ethical considerations were similar to those described above. In the collection of test-retest data there was a two month time interval between first and second CCS administrations

3. Results

3.1 Exploratory factor analysis

Inspection of data for the 60 items in the initial pool of CCS items showed that many items had markedly non-normal distributions, a high degree of skew being evident, with a ratio in excess of 4:1 participants endorsing options across the two opposing sides of the 6-point Likert scale (-3, -2, -1 vs. 1, 2, 3). These items, which tended to be items tapping internal causation of computing outcomes and chance/luck/fate as responsible for successful outcomes, were excluded from further analysis along with a few residual items tapping these issues[1].

Further analysis to refine the questionnaire proceeded in a manner recommended by Kline (2000). A scree plot associated with an initial Principal Components Analysis (PCA) carried out on the remaining items suggested that two factors existed in the data set. Inspection of output from a second, Principal Axis Factoring (PAF), run specifying oblique (Direct Oblimin) rotation of two factors revealed that items tapping the role of powerful others in determining computing outcomes failed to load highly on either factor.

With the above items excluded, a final analysis was performed. This obliquely rotated PAF run on the remaining 21 items revealed a correlation of -.34 between the factors, this being higher than the criterion of +/-.32 suggested by Tabachnick and Fidell (2001) as warranting oblique rotation.. The two factors in the solution accounted for around 35% of variance cumulatively. Factor One accounted for around 27% of variance and Factor Two for around 8% of variance. Table 1 gives item communalities, pattern matrix loadings and item wordings.

Insert Table 1 about here

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[1] Attempts to include skewed items both by using cluster analysis and by factor analysing data subsequent to its conversion into dichotomous variables had little impact upon the substantive conclusions reached: inclusion of items tapping internality and chance/luck/fate in such analyses resulted in an unclear cluster / factor structure, with reasonable structure only appearing when such items were deleted from analyses.

From the factor loadings in Table 1 it can be seen that the 21 items in the refined final instrument were factor pure, there being no cross-loadings greater than +/- .32. From item wordings the first factor was interpreted as Computing Autonomy. Here, 14 items designed to tap confidence in controlling computers and self-reliance when interacting with computers coalesced exclusively into a single bipolar factor, with the factor representing the extent to which people are autonomous in their use of computers in that they feel they can control them and solve computer-related problems without the help of others. Factor Two was interpreted as Need for Control (NControl), this bipolar factor loading upon all seven of the control motivation items in the final questionnaire.

3.2 Internal properties

In an initial test of the stability of the CCS factor structure, and to ensure that the solution was equally applicable to both sexes, the development sample was split on the basis of sex and analyses were conducted for males and females separately. Scree plots for two PCA runs suggested two factor solutions for both subsamples, and factor interpretations for subsequent PAF runs were the same as those for the whole sample analysis. Stability of factor structure across the two sexes was tested using two procedures recommended by (Tabachnick and Fidell, 1989, 2001). First, Pearson's r analyses compared the patterns and magnitudes of loadings between the pair of Autonomy factors and the pair of NControl factors from the sex-specific factor analyses. The analyses yielded values of $r(19) = .95$ ($P < .001$, one-tailed) and $r(19) = .93$ ($P < .001$, one-tailed) for the Autonomy and NControl factors respectively. These results suggested a high degree of stability for the whole sample solution, and that this solution applies to both males and females equally well. This conclusion was supported by a further comparison of loading patterns. With loadings in the hyperplane defined as those lower than +/-.32 (Tabachnick and Fidell, 1989), a significant value of Cattell's Salient Similarity Index (SSI) was obtained for the NControl factor (s = 0.92, hyperplane count = 67%, P < .001). Given the greater number of items on the Autonomy subscale, a low hyperplane count meant that evaluation of the SSI was not feasible for this subscale. On the other hand, a major reason why it is desirable to compute the SSI in addition to Pearson's r is that the presence of a large number of low loadings can inflate r (Tabachnick and Fidell, 1989). Thus, the low hyperplane count meant that this was not a great problem with respect to the Pearson's r analysis for the Autonomy subscale.

3.2.1 Cross-validation

Given that a number of variables were screened out prior to and during factor analysis, cross-validation of the final questionnaire on a new sample of respondents was necessary. Therefore PAF with oblique rotation was performed on data for the 203 students forming the cross-validation sample to test the replicability of the CSS factor structure.

The techniques used were the same as those used above for testing stability across the sexes. Comparison of patterns and magnitudes of loadings for factor pairs from the data for the development and cross-validation samples resulted in Pearson's r values of $r(19) = 0.96$ (P < .001 one-tailed) for the two sets of Autonomy loadings and $r(19) = 0.92$ (P <.001 one-tailed) for the two sets of NControl loadings. These results indicated a high degree of stability in factor structure across the two data sets. More support for replicability came from a comparison of patterns of loadings where a significant value of SSI was obtained for the NControl factor (s = 0.77, hyperplane count = 62%, $P < .001$). Again, evaluation of the SSI for the Autonomy subscale was not possible because of a low hyperplane count. But again this is not particularly problematical.

From the above analyses it can be concluded that the factor structure of the CCS is replicable. A copy of the final version of the CCS is included as an appendix.

3.2.2 Reliability

Subsequent to reverse coding of negatively phrased items, Cronbach's alpha coefficients for the two subscales on the data for the development sample showed the internal consistency of both subscales to be acceptable, alpha having a value of .88 for the Autonomy subscale and .73 for the NControl subscale.

Tests of temporal stability for 43 students across a two month time interval yielded Pearson's r coefficients of $r(41)= 0.79$ ($P < .001$, one-tailed) and $r(41)= 0.75$ ($P < .001$, one-tailed) for the Autonomy and NControl subscales respectively. Both of these coefficients indicated an acceptable level of test – re-test reliability.

3.3 Validity

Data for validation analyses was provided by members of the development sample described in the Method section. To allow a concise exposition, the precise demographic details for the subsamples of the development sample associated with each analysis are not given. Correlations (Pearsons *r* coefficients) between scores on the two CCS subscales and the various indices contained in the validation instruments are given in Table 2.

In deriving subscale scores, responses on the items of each subscale were summated with scoring keyed so that higher scores were commensurate with the two subscale names: higher computing autonomy and need for control.

Insert Table 2 about here

3.3.1 Relationships with the Revised Computer Apathy and Anxiety Scale

It was not possible to develop hypotheses involving the Autonomy subscale prior to factor analysis because it was assumed that Locus of Control and Confidence in Controlling Computers factors, rather than an Autonomy factor, would exist. However, subsequent to factor analysis it was possible to formulate hypotheses involving differential relationships between the Autonomy and NControl subscales and scores on the various validation instruments. As far as the CAAS-R computer anxiety – comfort subscale was concerned, it was hypothesized that people exhibiting greater comfort with computers would be able to use them with greater autonomy. However, feeling comfortable with computers would not be expected to say anything about one's need for control over them (in fact, an excessive need for control might be considered as tending towards pathology – as implied by the rationale developed in the Introduction for the hypothesis involving the CAAS-R Computer Addiction subscale). Therefore, a null Comfort – NControl relationship was hypothesized. The correlations in Table 2 supported this differential prediction. Computer Comfort scores were more positively related with CCS Autonomy scores than with CCS NControl scores. Furthermore, Williams' test for differences between non-independent correlations revealed a significant difference between the two coefficients ($t(121)= 8.77$, $P < .001$, one-tailed).

Reference to Table 2 also reveals support for the hypothesis that greater computing need for control would exhibit a particularly high relationship with computer addiction. The correlation between these two variables was significant and the magnitude of this coefficient was significantly greater than that for the Computing Autonomy – Computer Addiction relationship ($t(121)= 2.15$, $P < .05$, one-tailed).

The high CCS Autonomy – CAAS-R Comfort coefficient in Table 2 shows that scores for these two measures shared around 56% of their variance. Confirmatory factor analysis (CFA) of standardized scores was therefore performed to ensure that the distinction between the two constructs underlying these two subscales was factorially valid.

The CFA was performed using EQS 5.7a (Bentler, 1995) and specified two correlated factors corresponding to Autonomy and Comfort. The analysis showed that the two factors loaded significantly ($P < .05$) on all of their respective items, with loadings in the range +/- 0.25 to +/-0.81 for the Autonomy factor and +/- 0.40 to +/- 0.83 for the Comfort factor. A significant chi-square goodness of fit statistic for the analysis revealed a lack of fit between the data and the hypothesized factor structure ($\chi^2(431) = 721.42$, $P < .001$). However, there are many problems with the chi-square statistic and consideration of the ratio of chi-square to its degrees of freedom provides a better approximate assessment, with a ratio of less than 2 indicating a reasonable fit (Ullman, 2001). With a ratio of 1.67 then, the above chi-square statistics suggested an acceptable fit. This conclusion was supported by a root mean square error of approximation lower than 0.10 (RMSEA = 0.073, 90% confidence interval = 0.063 - 0.082). While the (commonly reported) comparative fit index of 0.83 was lower than the value of 0.90 considered acceptable, RMSEA is the favored index in personality-oriented CFA studies (Raykov, 1998).

Overall then, it can be concluded that, although highly related, the CCS Autonomy and CAAS-R Comfort subscales are factorially distinct.

3.3.2 Correlations with the Internality, Powerful Others and Chance Scales

As far as correlations between the CCS subscales and the IPC locus of control subscales are concerned, in general moderate correlations would be expected between scores on a domain-specific scale and a general locus of control scale. However, because items tapping attributions to internality, powerful others and chance/luck/fate were removed during analysis of the CCS data, the rationale for including this instrument as a validation measure diminished during the study. Nevertheless, given relationships observed between scores on Levenson's scales and scores on Burger and

Cooper's DC Scale (Burger, 1984, 1992) analysis of the relationships between scores for the two CCS subscales and Levenson's scales is presented. It will be remembered from the Introduction that a positive correlation was expected between NControl scores and Levenson Internality scores, with correlations between NControl and both externality scores (Powerful Others and Chance) being expected to be lower in absolute magnitude and negative. Given the material in the Introduction suggesting that internals are more likely to master their environment and thereby develop greater computing confidence, a positive correlation was also expected between CCS Autonomy scores and Internality scores. No hypotheses were forwarded with respect to Autonomy and the two external IPC scales.

Consistent with the validation hypothesis, Table 2 shows a significant positive relationship between CCS NControl scores and Internality scores, this being the only significant correlation between NControl and the Levenson subscales. However, contrary to hypothesis, there was no significant correlation between CCS Autonomy scores and Internality scores, the coefficient approaching zero.

3.3.3 Correlations with Desirability of Control

As a domain-specific subscale aimed at tapping a broadly similar construct to that tapped by the global DC scale, it was expected that scores on the CCS NControl subscale should exhibit a reasonable correlation with DC scores, and Table 2 supports this hypothesis. As would be expected, the table also shows that NControl scores were more highly correlated with DC scores than CCS Autonomy scores were. However, contrary to the ideal situation, the NControl – DC and Autonomy – DC coefficients were not significantly different ($t(58)= 0.85$, $P > .05$, one-tailed).

3.3.4 Socially desirable responding

The minimal correlations between scores on the two CCS subscales and Marlowe-Crowne scores in Table 2 indicate that the CCS does not have a tendency to induce socially desirable responding.

3.4 Subscale descriptive statistics for different sexes and occupational groups

Because of the general thrust of the literature showing greater male computing involvement, it is useful to present some information on sex differences for the two presently developed indices. Table 3 contains descriptive statistics for the development sample. Two independent samples t-tests on the means in Table 3 showed males as having significantly greater computing autonomy ($t(234) = 1.93$, $P < .05$, one-tailed), but not significantly greater computing need for control ($t(235) = 0.65$, $P > .05$, one-tailed).

Insert Table 3 about here

Finally, to facilitate comparisons that future researchers might wish to make, Table 4 gives descriptive statistics for different vocational groups. Note that if elimination of negative scores from a data set is considered desirable (e.g. for the purposes of dissemination to respondents), this can be done by adding a constant of 42 to Autonomy scores and 21 to NControl scores.

Insert Table 4 about here

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4. Discussion

In its final version, the CCS consists of Computing Autonomy and Computing Need for Control subscales. The factor structure of the CCS has been shown to be robust, its subscales to be internally consistent and scores on them to be temporally stable. Some initial evidence in support of the subscales' validity has also been presented. As would be expected, computing autonomy bore a greater relationship with computer comfort than computing need for control did, but, again as expected, the computing need for control – computer addiction relationship was greater than the autonomy – addiction relationship. Nevertheless, as one would expect intuitively, there was a reasonably sized relationship for this latter pair of variables. The pattern whereby the Levenson Internality subscale exhibited a greater relationship with Need for Control than the other Levenson scales was the same as the patterns observed by Burger (1984, 1992) for his DC scale, although studies involving the DC scale show slightly larger (negative) correlations with the other two Levenson scales, than the null correlations in the present study. While computing need for control exhibited a higher correlation with Burger and Cooper's (1979) global desirability of control than computing autonomy did, the difference in magnitude of the two coefficients was non-significant. Recalling that factor analysis of the DC scale has revealed an Avoidance of Dependence factor (Burger, 1992), on reflection perhaps the non-significance of this difference is not surprising.

Analysis of sex differences showed that males scored significantly higher on the Autonomy subscale. This is consistent with the general thrust of the previous literature showing greater male involvement in computing, in the form of, for example, lesser male computer anxiety and greater male computer self-efficacy (see Brosnan, 1998 and Durndell & Haag, 2002 for recent reviews). The non-significantly greater Computing Need for Control score of males was consistent with the small effect sizes found in non-domain-specific research where a slight, but often non-significant, tendency for males to exhibit greater desire for control exists (Burger, 1992).

4.1 The constructs of computing need for control and autonomy

Computing need for control represents a domain-specific analog of Burger's global desire for control construct. If observations relating to the global construct generalize to the computing domain, people high in computing need for control would be expected to exhibit a high degree of motivation in their control attempts within computing environments. In general this would be likely to lead to greater computing success. However, there is also likely to be a negative side in that such individuals would be expected to exhibit signs of unease and / or stress when faced with uncontrollable computing situations. The present validation efforts also supported the idea that a greater need for control might be a risk factor in the development of addiction to certain computing activities as speculated by Weizenbaum (1984), Shotton (1989) and Levy (1994).

The newly developed notion of computing autonomy is a hybrid construct involving confidence in controlling computers (a construct similar to perceived self-efficacy in controlling computers) and the extent to which people display self-reliance in their interactions with computers. The merging of the two types of item into a single factor is a robust phenomenon in that it was replicated across factor analyses for both the development and cross-validation samples. It is also useful to note that an (unreported) analysis imposing a three factor solution on the data for the development sample still resulted in a first factor consisting of a mixture of self-reliance and confidence items, rather than the autonomy factor splitting into distinct self-reliance and confidence factors. There is an obvious logical connection between the two facets involved in the autonomy construct in that people who perceive that they have difficulties in controlling computers will tend to feel reliant upon others in situations where they find control difficult. For the most part, high computing autonomy can be viewed as a positive attribute since it represents a willingness to explore computing environments and the functioning of software packages to exert control when faced with computing problems. This should lead to greater knowledge of, and comfort within, computing environments, which in turn should lead to even greater autonomy, thereby establishing a virtuous circle of causality. Thus, comfort in using computers is bound to go hand-in-hand with an ability to use them autonomously. It was therefore encouraging to find that confirmatory factor analysis showed that computer comfort (the opposite of computer anxiety) and computer autonomy are distinguishable. It is necessary to note though that not all validation hypotheses involving the Autonomy subscale were supported. In particular, although there is much previous evidence suggesting that people with an internal locus of control are more likely to master their environment and therefore one validation hypothesis proposed a positive relationship between autonomy and internality, such a relationship was not observed. The reason for this is unclear.

A small relationship exists between computing need for control and computing autonomy, the factors in the analysis for the development sample exhibiting an absolute correlation of 0.34. This indicates that responses on the two scales have around 12% of their variance in common. This correlation is reasonable given that people with a high need for control would be expected to be autonomous in their interactions with computers because their high motivation to control computers should result in a greater amount of time spent using computers. This greater experience would be expected to result in higher computing proficiency and thereby greater autonomy. However, from a psychometric perspective the correlation is low enough to allow use of the two subscales as independent predictors in statistical analyses.

4.2 Problems in measuring computing locus of control

The present attempt to develop a computing-specific locus of control measure did not bear fruit. Many of the items aimed at tapping particular facets of locus of control were highly skewed, hardly anyone agreeing or disagreeing with certain types of statement. These observations have implications for both theory and future scaling efforts in the area of computing locus of control. For example, few people (less than 10%) expressed disagreement with statements such as ‘My being able to use computers is not just a matter of chance’, and agreement with statements such as ‘I attribute most of my failures when computing to bad luck’ and ‘A lot of my success when computing just depends upon whether I am having a lucky day’. It seems then that most people accept that chance and luck play little part in the outcomes of their interactions with computers. Also, most people have an internal orientation towards computing, accepting that they can influence the outcomes of their interactions with computers by their own efforts. Few people agreed with statements such as ‘Increasing the amount of time I spend learning about computers would not make me any better at using them’ (only 12% agreement) and ‘It is no use me trying to be good at computing’ (only 7% agreement), or disagreed with a statement such as ‘I can have a great influence upon whether I am good at computing’ (only 9% disagreement). Thus, from the present results it appears that attempts to construct computing-specific scales measuring locus of control dimensions such as internality, luck and chance is likely to be difficult using factor analytic methods. Nevertheless, the present data shows that a small proportion of people might still be at an educational or vocational disadvantage because of low internality and / or high externality with respect to computing situations. Therefore future attempts to develop an instrument using other methods, such as criterion-keying, would be worthwhile.

Because previous research has used general locus of control measures rather than developing computing-specific measures, it is unclear whether most people’s computer-related control expectancies have always veered towards internality and away from externality. Certainly, the almost universal adoption of graphical user interfaces such as Windows over the past decade is likely to have bolstered such an expectancy pattern, since these interfaces make human-computer interaction easier and altogether more intuitive than was previously possible. Whatever the case may be, experience appears to have taught most people that computing outcomes are usually controllable if one has a deep enough knowledge of computers, despite the fact that they may sometimes be faced with uncontrollable events such as crashing or hanging.

Another reason for the present observations concerning computing locus of control items might be that, similar to cars, video recorders etc., computers are objects upon which physical actions (e.g. pressing buttons and keys) usually have a demonstrable effect, and therefore if one knows which actions to perform one will be largely successful. This contrasts with the situation regarding life occurrences such as health, occupational progression etc. Here, the factors that influence outcomes can be unpredictable and unknown, are often demonstrably so, and experience and observation often tells people that, despite their best efforts at control, certain outcomes might occur.

4.3 Failure to develop autonomy

The present findings imply that although most people agree that in principle computing outcomes are within their control, many people's feelings of control over computers are so fragile that they feel a need to rely upon others in difficult computing situations. Thus, rather than people entertaining the idea that computing outcomes are fundamentally uncontrollable, the issue appears to be one of some people lacking the confidence in their ability to control computers to the extent that they need to rely upon others in difficult computing situations. Equating confidence with self-efficacy (Ajzen, 2002), this supports Bandura's (1997) observation that locus of control and self-efficacy beliefs are largely independent of each other. On the question of why some people fail to develop autonomy in their use of computers despite a belief that outcomes are fundamentally controllable, one possibility is that many people accumulate years of computing experience without ever really developing a sense of mastery over computers, because of a reluctance to go beyond the necessary basics in their interactions with computers. For such people, the increase in confidence / self-efficacy in controlling computers which would generally be expected to be a concomitant of increasing experience might never materialize. This is supported by findings that computing experience does not always alleviate computer anxiety or increase computer self-efficacy (Marcoulides, 1988; Cassidy and Eachus, 2000). In explaining such findings, Cassidy and Eachus (2002) suggest that it is '…quality not quantity…' of experience that determines computing self-efficacy beliefs: it is perhaps not simply number of hours of computing experience accumulated that is important, but experience in terms of depth of use of packages and in the range of applications used that fosters a sense of self-efficacy / confidence in controlling computers. Reasons why certain people may be reluctant to go beyond the basics in their interactions with computers are likely to include some of those discussed by Brosnan (1998) in relation to technophobia. For example, historically computers have been portrayed as highly masculine objects, making them respectively more and less appealing to individuals characterized by masculine and feminine psychological gender (the possibility that such an explanation might account partially for differences in autonomy is heightened by the present finding of greater male autonomy). Also, the analytical approach represented by a field independent cognitive style has been said to make an individual more suited to interactions with computers than has the more holistic field dependent cognitive style.

4.4 Conclusions

From an applied perspective, the development of the CCS is particularly important because it opens the way for research into need for control in the field of human-computer interaction. For example, studies of the extent to which a high need for control plays an important part in mediating stress associated with non-optimally responding computers and slow Internet download times might be fruitful, as might studies examining need for control's role in explaining computer-related addictions. Also, it might be expected that employees and students who are high in computing need for control would perform best in situations where computing environments allow them a lot of scope for individual control, perhaps with less automation, whereas those lower in need for control might prefer environments which include a greater number of automated features. Thus, individual differences in need for control might be one reason why meta-analysis shows that the effects of giving learners greater control over the learning process in computer assisted instruction programs are small but negative, students on the whole being shown to learn slightly better without such control (Niemiec, Sikorski & Walberg, 1996). It is possible that studies mix students who might be expected to benefit from such environments (high need for control) with those who would not, or might even not desire such environments (low need for control).

With the introduction of intelligent agents on the horizon, it is probable that individual differences in need for control over computers will become of even greater significance than they are at present. Intelligent agents are computer software and / or systems that operate autonomously once a task has been defined. Their use will require computer users to relinquish control over tasks, and individuals with a high need for control over computers are likely to find this uncomfortable. It will therefore be important for organizations to consider the extent to which individual differences in need for control will make the introduction of such technology into the working environment desirable.

Further investigation of the construct measured by the CCS Autonomy subscale could consist of assessing whether it is a better predictor of the degree to which people exhibit autonomous computing behavior than measures of constructs such as computer anxiety. An obvious use of the Autonomy subscale would be to measure the success of educational courses in terms of their fostering of the ability to use computers autonomously.

To conclude, evidence has been presented that the factor structure of the CCS is replicable and that its subscales are reliable. Initial studies also suggest that the subscales are valid measures of computing need for control and autonomy. It is considered that the CCS has the potential to be a useful addition to the tools available to researchers interested in the way humans interact with computers.

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Appendix A

The Computing Control Scale

Name: ______________________________ Course / Occupation ___________________________

Age: ______ Gender: M / F (Delete as appropriate)

Directions

In this questionnaire you will find a number of statements concerning computers and their use.

Please read each statement and indicate the extent to which the statement summarizes your thinking by circling which of the six numbers on the right hand side of the page most nearly corresponds to your level of agreement with the statement. Note that there are no right or wrong answers, all that is required is that you circle the response which best applies to you. Do not worry if your answers seem inconsistent, and please avoid referring to your responses to previous statements when responding to each statement.

The options and their meanings are indicated as follows:

-3	-2	-1	+1	+2	+3
Strongly Disagree	Moderately Disagree	Slightly Disagree	Slightly Agree	Moderately Agree	Strongly Agree

Remember, if none of the options exactly summarizes your thinking, please just circle the option that is closest. Please ensure that you give a response to each statement, and do not select more than one option per statement

1. I feel powerless in many computing situations ………………………………………………………	-3	-2	-1	1	2	3
2. If I have a computing problem I usually try to solve it myself ………………………………………………	-3	-2	-1	1	2	3
3. Having the skills to be able to exert great control over computers is not particularly important to me ……..	-3	-2	-1	1	2	3
4. I can make a computer do what I want if I put my mind to it ………………………………………………..	-3	-2	-1	1	2	3
5. Even if I know the relevant information is available, I prefer to ask someone who is more knowledgeable to solve my computing problems ……………………………………………………………………….	-3	-2	-1	1	2	3
6. When I get a computer to do what I want it gives me a feeling of power ……………………………………	-3	-2	-1	1	2	3
7. No matter how much I tried to become good at using computers, I would always find it difficult to control what computers do ………………………………………………………………………………	-3	-2	-1	1	2	3
8. I look at help screens or manuals rather than ask someone if I want to learn how to do something new with a computer ………………………………………………………………………………………	-3	-2	-1	1	2	3
9. I derive no thrill from being able to complete a difficult computing task ……………………………………	-3	-2	-1	1	2	3
10. I find it hard to learn how to use software packages without having someone there to teach me …………..	-3	-2	-1	1	2	3
11. If I have a computing problem it plays on my mind until I sort it out ……………………………………….	-3	-2	-1	1	2	3

12. When I use a computer I try to avoid doing anything too complicated as long as things are going basically right …… -3 -2 -1 1 2 3

13. As long as I can get a computing task done, the extent to which I can control the computer when performing the task does not bother me …… -3 -2 -1 1 2 3

14. When I am using a new computer software package I like to be able to master all of its features as quickly as possible …… -3 -2 -1 1 2 3

15. To me, computers seem to have a mind of their own …… -3 -2 -1 1 2 3

16. I do not expect my friends or relatives to have to sort out my computing problems …… -3 -2 -1 1 2 3

17. If a computer is going to act-up, there is nothing I can do to stop it …… -3 -2 -1 1 2 3

18. Usually, when I have a problem using a computer the first thing I do is call somebody else …… -3 -2 -1 1 2 3

19. I like computers because they give me the opportunity to feel in control of things …… -3 -2 -1 1 2 3

20. Few of the things that happen when I am using a computer are beyond my control …… -3 -2 -1 1 2 3

21. I would not start to use a new software package without having had some training in it first …… -3 -2 -1 1 2 3

Table 1

Item listings and factor pattern loadings for the two factor PAF solution

	Factor 1 (Autonomy)	Factor 2 (Need for Control)	h^2
Factor 1- Computing Autonomy			
L1. I feel powerless in many computing situations	.80	.03	.62
L10. I find it hard to learn how to use software packages without having someone there to teach me	.75	-.08	.59
L18. Usually, when I have a problem using a computer the first thing I do is call somebody else	.71	-.12	.56

L7.	No matter how much I tried to become good at using computers, I would always find it difficult to control what computers do	.62	.01	.38
L8.	I look at help screens or manuals rather than ask someone if I want to learn how to do something new with a computer	-.61	.03	.39
L5.	Even if I know the relevant information is available, I prefer to ask someone who is more knowledgeable to solve my computing problems	.60	.02	.35
L12.	When I use a computer I try to avoid doing anything too complicated as long as things are going basically right	.59	-.14	.42
L2.	If I have a computing problem I usually try to solve it myself	-.58	.14	.41
L15.	To me, computers seem to have a mind of their own	.55	.02	.30
L4.	I can make a computer do what I want if I put my mind to it	-.50	.10	.30
L21.	I would not start to use a new software package without having had some training in it first	.50	.09	.29
L16.	I do not expect my friends or relatives to have to sort out my computing problems	-.47	-.09	.21

L17. If a computer is going to act-up, there is nothing I can do to stop it	.35	-.21	.21
L20. Few of the things that happen when I am using a computer are beyond my control	-.35	-.10	.11
Factor Two – Need for Control			
L19. I like computers because they give me the opportunity to feel in control of things	-.08	.70	.53
L6. When I get a computer to do what I want it gives me a feeling of power	.31	.69	.43
L9. I derive no thrill from being able to complete a difficult computing task	.02	-.59	.35
L3. Having the skills to be able to exert great control over computers is not particularly important to me	.08	-.48	.26
L11. If I have a computing problem it plays on my mind until I sort it out	-.13	.48	.28
L13. As long as I can get a computing task done, the extent to which I can control the computer when performing the task does not bother me	.14	-.38	.20

L14.	When I am using a new computer software package I like to be able to master all of its features as quickly as possible	-.19	.33	.18

Table 2

Correlations for validation of the CCS subscales

	CCS Autonomy	CCS NControl
CAAS-R		
Computer Addiction	.27*** [a]	.48*** [a]
Computer Comfort	.75*** [b]	.09 [b]
Levenson I,P,C Scale		
Internality	.09 [c]	.23* [c]
Powerful Others	-.09 [c]	.02 [c]
Chance	-.13 [c]	.05 [c]
Burger and Cooper DC Scale	.11 [d]	.26* [d]
Marlowe-Crowne	.05 [e]	.07 [e]

$*P < .05$, $***P \leq .001$ one-tailed, [a]df=120, [b]df=121, [c]df=79, [d]df=54, [e]df=50

Table 3

Sex differences on the CCS subscales

	CCS Autonomy[a]			CCS NControl[b]		
	n	*M*	*SD*	*n*	*M*	*SD*
Females	144	9.49	16.19	146	1.00	7.75
Males	92	13.71	16.76	91	1.70	8.64

Maximum possible scores: [a] = 42 [b] = 21, Minimum possible scores: [a] = -42 [b] = -21

Table 4

Descriptive statistics for the three major occupational groups in the development sample

	CCS Autonomy[a]			CCS NControl[b]		
	n	*M*	*SD*	*n*	*M*	*SD*
Students	56	9.13	14.63	56	1.80	6.94
Technical/Professional	130	11.17	17.53	130	0.62	8.31
Clerical/Secretarial	41	12.66	15.50	42	2.69	8.66

Maximum possible scores: [a] = 42 [b] = 21, Minimum possible scores: [a] = -42 [b] = -21